

# Application of Entropy-Weight Method in Curriculum Evaluation System

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## ABSTRACT

Because the curriculum evaluation system is of great significance for the identification of curriculum quality. The emphasis of curriculum evaluation lies in the evaluation index and weight. According to the index system of classroom quality evaluation, this paper uses entropy weight method and Delphi method to construct a classroom quality evaluation index system of methodology courses, which includes three first level indexes of teaching process, teaching method and teaching effect and 17 second level indexes.

**KEYWORDS:** Methodology course; Index system; Delphi method

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## INTRODUCTION

Graduate students training not only needs to cultivate their theoretical literacy, but also improves their ability to complete scientific research tasks. The teaching purpose of methodology course is to help graduate students learn and understand standardized research methods. In recent years, in order to improve the research ability of postgraduates, many universities such as Tsinghua University and Nanchang University have offered methodology courses in the postgraduate training programs. Evaluating the classroom teaching quality of methodology courses is helpful to improve the classroom teaching and improve the teaching quality.

### 1. The research status

In the research of existing methodology courses, most scholars focus on the importance and significance of the existence of methodology courses. Such as Zhao Yuxin(2015) It is believed that the talents trained by higher education should be talents with both professional knowledge and creative thinking. Introducing research methodology teaching in higher education is conducive to helping college students build a scientific research ability system, but there is still a big lack in the training of research methodology in China, which can be seen from students' research topics, literature research and dependence on tutors; Yudengk(2016) It is believed that setting up methodology courses can help students master research methods scientifically and systematically; Sunshibing(2014) and other scholars believe that entering

the methodology in the postgraduate education stage will help cultivate their ability to handle events correctly and effectively; Wujiannan(2014) and other scholars found that Britain and the United States attach importance to the cultivation of practical ability of postgraduates, and both set methodology courses as compulsory subjects for postgraduates, and attach importance to the training of students' research methods to improve the quality of students' cultivation. Foreign universities attach importance to such courses, which is worth learning.

As can be seen from Table 2 and Figure 1, the key research direction of classroom teaching quality evaluation in China at present is mainly to construct the quality evaluation index system of classroom teaching buildings for college courses. When constructing the evaluation index system, most scholars will choose students as the main body for evaluation from the perspective of students.

Different scholars have different evaluation index systems according to different curriculum characteristics. Such as Wang Junming(2020) and other scholars have finally built a classroom teaching quality evaluation index system with teaching scheme, strategy and effect as the first-class indicators through Delphi method; Qiuwenjiao(2016) and other scholars have made many revisions through multi-party consultation, and constructed inquiry-based classroom teaching evaluation indicators from three aspects: teachers, students and inquiry effects; Wu Guoyu(2015) and other scholars revised the initially

constructed indicators by issuing questionnaires, and finally built an index system including seven first-level indicators: teaching enthusiasm, teaching content, learning value, and homework assessment. Zhaoxinrui(2019) and other scholars use the analytic hierarchy process to build a six-dimensional evaluation index system including teaching team, teaching activities,

teaching evaluation and feedback based on the basic requirements of the curriculum for talent training and teaching process; Yue Qi and Wen Xin(2018) An index system including teachers' quality, teaching attitude, teaching content, teaching method and teaching effect was constructed.

## 2. The preliminary construction of teaching quality evaluation indicators

The purpose of teaching quality evaluation is to find out the shortcomings in teaching and further improve it, so that the teaching quality can be improved and the task of student training can be completed better. According to the customer perceived quality model, in order to comply with the customer-centered concept, manufacturers should evaluate the quality of goods from the customer's point of view. This model is also applicable to the evaluation of teaching quality. The starting point of curriculum teaching is to serve students and take students as the center. Therefore, when evaluating classroom teaching quality, students should be asked to evaluate it. Combined with previous studies, this paper will draw up the evaluation index of classroom teaching quality of methodology courses from three dimensions: teaching process, teaching method and teaching effect.

**Table 1 Preliminary evaluation index table of classroom quality of methodology courses**

Primary index	Secondary index	Three-level index
A1 teaching process	B1 classroom atmosphere	C1 has a high degree of interaction between teachers and students, and students can have a sense of participation in the classroom
		C2 classroom learning atmosphere is strong, and teaching auxiliary facilities and tools are complete
	B2 teaching content	C3 teaching content is properly connected with undergraduate course without obvious fault.
		C4 teaching content is focused, hierarchical and easy for students to master
		The content structure of C5 is systematic, which helps students to establish a systematic thinking system
		C6 combines theoretical knowledge to discuss the latest research results and research trends of the discipline
		C7 discusses the teaching contents of methodology courses according to topics or shows cases.
	Guidance under lesson B3	C8 guides students to train related research methods after class
		C9 guides students' problems in practical application after class
A2 teaching method	B4 diversity	C10 A variety of teaching methods are combined, and the appropriate method is selected according to the needs of the teaching content
	B5 guidance	C11 adopts the enlightening method, which allows students to explore and discover themselves and improve their creativity
		C12 adopts the method of discussion, which enables students to inspire each other, think independently and get rid of dependence
	B6 practicality	C13 adopts example teaching to make students understand how to apply research methods in practical cases
		C14 adopts practice teaching and carries out relevant exercises according to the content of methodology course
A3 teaching effect	B7 knowledge harvest	C15 can well absorb and master the teaching content of this course
		C16 is able to apply the theoretical knowledge to practical problems
	B8 capacity improvement	C17 can master the standard research methods and complete scientific research tasks independently
		C18 can form a scientific thinking system and form its own thinking on relevant issues

## 3. Research methods

### 3.1. Delphi method

Delphi method is a non-interference way of discussion. The experts concerned are organized into an expert group and members of the group are guaranteed to have "back-to-back" discussions on the same issue. The steps of Delphi method are as follows: the research group formulates the questionnaire according to the research content and sends it to the expert group; the expert group discusses, and the research group summarizes and analyzes the discussion results, and then sends it to the expert group. Repeat the above steps until the coordination of experts, that is, the consensus reaches a certain standard, stops, and takes the final discussion result as the prediction result.

### 3.2. Entropy weight method

The method of using entropy weight method to determine the index weight has been widely used in the research of index system construction.

First, standardize the values of the data. Assuming that K indicators are given, the standardized value of each index data is

$$Y_{ij} = \frac{X_{ij} - \min(X_i)}{\max(X_i) - \min(X_i)}$$

Secondly, according to the standardization results obtained in the first step, the information entropy is calculated. According to the definition of information entropy in information theory, the information entropy of a group of data is

$$E_i = -\ln(n)^{-1} \sum_{j=1}^n p_{ij} \ln p_{ij}$$

among  $p_{ij} = \frac{Y_{ij}}{\sum_{j=1}^n Y_{ij}}$ , if  $p_{ij} = 0$ , then define  $\lim_{p_{ij} \rightarrow 0} p_{ij} \ln p_{ij} = 0$ .

Third, determine the weight of each index. According to the formula:

$$W_i = \frac{1 - E_i}{k - \sum E_i} (i = 1, 2, \dots, k)$$

Calculate the weight of each index, where  $E_i$  is information entropy.

#### 4. Research design

##### 4.1. Determined by experts

The experts selected in this study are teachers of methodology courses in Colleges and universities, with rich teaching experience and knowledge reserve. When Delphi method is used for expert consultation, the determination of the expert group is best controlled within 20 people. Considering the factors such as the research topic in this paper, 15 people are finally selected to form the expert group.

##### 4.2. Expert consultation

###### 4.2.1. Basic information of experts

The number of experts in this study was determined to be 16. In terms of gender distribution, there are 6 men and 10 women; in terms of professional titles, there are 5 professors, 3 associate professors and 8 lecturers.

###### 4.2.2. Enthusiasm of experts

Referring to the previous literature, this study will use the questionnaire recovery rate as an indicator to reflect the enthusiasm of experts. The higher the questionnaire recovery rate is, the more active the experts are. In the first round of consultation, questionnaires were distributed to 16 members of the group, and one person did not return the questionnaire. A total of 15 valid questionnaires were collected. The recovery rate of the first round of questionnaire was 93.75%; in the second round of consultation, all the questionnaires were collected and the recovery rate reached 100%. It can be seen from the above that the recovery rate of the two rounds of questionnaires is at a high level, which indicates that the members of the expert group actively cooperate with the consultation and have a high degree of enthusiasm.

###### 4.2.3. Expert authority

In this study, the authority coefficient (CR) is used to measure whether the members of the expert group have certain authority to ensure the credibility of the consultation results. The calculation formula of the authority coefficient (CR) is  $Cr = (Ca + Cs) / 2$ , in which  $Ca$  is the basis for experts to score each index in the index system, and  $Cs$  is the familiarity of experts with the research problem.  $Ca$  and  $Cs$  are assigned on the following basis:

**Table 2 evaluation basis of experts for this research index**

Judgment basis	Degree of evidence		
	large	in	Small
theoretical analysis	0.3	0.2	0.1
practical experience	0.5	0.4	0.3
Peer understanding	0.1	0.1	0.1
Intuitive judgment	0.1	0.1	0.1

**Table 3 assignment table of experts' familiarity with this research index**

Familiarity	Very unfamiliar	be unfamiliar with	common	be familiar with	Very familiar
evaluation	0	0.2	0.5	0.8	1

According to the assignment basis, the calculation result of  $Cr$  is 0.89, which indicates that the experts selected in this study have a high degree of authority and the consultation results have credibility.

**Table 4 Authority degree of experts**

Judgment basis $Ca$	Familiarity $Cs$	Authority degree $Cr$
0.85	0.93	0.89

###### 4.2.4. Degree of expert coordination

In this study, the coefficient of variation (CV) and Kendall coefficient (W) are used to measure the coordination degree of experts. Coefficient of variation is the ratio between the average difference and the average value of each index, which is used to measure the coordination degree of experts to each index. The smaller the value of CV, the better the coordination of experts, and the general coefficient of variation (CV) < 0.25, the better the coordination degree of this index, that is, the consensus among the members of the expert group is higher.

The calculation formula of Kendall coefficient (W) is:  $W = \frac{12}{m^2(n^3-n)} \sum_{j=1}^n d_j^2$ , where m is the consulting expert n is the number of evaluation objects,  $\sum_{i=1}^n d_j^2 = \sum_{i=1}^n (S_j - M_{sj})^2$ .  $S_j = \sum_{i=0}^{m_j} R_{ij}$ ,  $R_{ij}$  Score the j-th index for the i-th expert,  $S_j$  is the sum of the scores of the j-th index;  $M_{sj} = \frac{1}{n} \sum_{j=1}^n S_j$  arepresents the arithmetic mean of the sum of the j-th index scores.

When different experts have the same score for a certain index, W needs to be corrected. The correction formula is:  $W' = \frac{12}{m^2(n^3-n)-m \sum_{i=1}^L T_i} \sum_{j=1}^n d_j^2$ , where  $T_i = \sum_{i=1}^L (t_i^3 - t_i)$ , L represents the number of groups with the same score given by the i-th expert, and  $t_i$  represents the number of the same level of the i-th expert in the L group.

By calculating the coefficient of variation of each index, it can be seen that the CV value of each index finally determined in this study is less than 0.25. At the same time, the Kendall coefficient of each index is calculated by SPSS 25.0. The results of the first round of expert consultation are:  $W=0.214$ , and  $P<0.001$ , which is obviously significant; The result of the second round of expert consultation is:  $W=0.256$ , and  $P<0.001$ , which is obviously significant. From the above results, we can see that the Kendall coefficient of the two rounds of expert consultation is at a higher level, and the Kendall coefficient of the second round of expert consultation is higher.

According to the above calculation results of CV and W, it can be seen that the consensus of experts is high, so the discussion will be stopped and the third round will not be conducted.

**Table 5 Expert coordination coefficient table**

	Kendall W	chi-square	P value
first inning	0.214	54.523	<0.001
Second round	0.256	61.374	<0.001

## 5. the construction of index system

Drawing lessons from the previous practice, delete the indicators in the first round of consultation with the index score  $\geq 4$  points and the number of people less than 80%, after finishing, the indexes C2, C3 and C10 are deleted.

After deleting the unsatisfactory indicators, based on the revised opinions of experts sorted out in the two rounds of consultation, this study revised the initial indicators as follows: First, some experts believe that methodology courses pay attention to cultivating students' thinking, so the classroom atmosphere in which students find and ask questions is an important feature of methodology courses. This study recognizes this view and adds it to the secondary indicator "classroom atmosphere"; Secondly, some experts believe that it should be in line with the professional direction. Since the main goal of graduate methodology courses is to cultivate the research ability of graduate students, attention should be paid to the integration of courses and majors. This study adopts this suggestion and adds it to the secondary index "teaching content"; Third, some experts pointed out that students should be instructed to conduct in-depth research on teaching content. This study adopts this suggestion and adds this index to the secondary index "practicality"; Fourthly, some scholars think that index C13 is duplicated with index C7, and the content of index C13 does not conform to the dimension of "teaching method", so index C13 should be deleted, and this opinion is adopted in this study. Fifthly, some scholars pointed out that some indicators in this study were unclear, so this study modified some indicators in terms of language expression according to experts' suggestions.

According to the score value of each index, the entropy weight method is used to calculate the weight of each index, and finally the index system is determined as shown in the following table:

**Table 6 Evaluation Index System of Classroom Teaching Quality of Methodology Courses**

Primary index	weight	Secondary index	weight	Three-level index	weight
A1 teaching process	0.552	B1 classroom atmosphere	0.144	C1 has a high degree of interaction between teachers and students, and students can have a sense of participation in the classroom	0.707
				C2 students actively explore the connection between teaching content and their majors	0.293
		B2 teaching content	0.782	C3 teaching content is in line with students' own professional direction	0.054
				C4 teaching content is focused, hierarchical and easy for students to master	0.295
				The content structure of C5 is systematic, which helps students to establish a systematic thinking system	0.314
				C6 discusses the teaching content of methodology course according to the topic or the case shows the dynamic discussion	0.240
				C7 combines theoretical knowledge, the latest research results and research of disciplines	0.097
		Guidance under lesson B3	0.073	C8 guides students to carry out course-related training after class	0.341
				C9 gives guidance and feedback to students' problems and performance in practical application after class	0.659



A2 teaching method	0.278	B4 guidance	0.599	C11 adopts the enlightening method, which allows students to explore and discover themselves and improve their creativity	0.765
				C12 adopts the method of discussion, which enables students to inspire each other, think independently and get rid of dependence	0.235
		B5 practicality	0.401	C12 uses example teaching to let students understand how to apply research methods in practical cases	0.151
				C13 guides students to explore the teaching content deeply	0.849
A3 teaching effect	0.170	B6 knowledge harvest	0.269	C14 can well absorb and master the teaching content of this course	0.611
				C16 is able to apply the theoretical knowledge to practical problems	0.389
		B7 ability improvement	0.731	C17 can master the standard research methods and complete scientific research tasks independently	0.591
				C18 can form a scientific thinking system and form its own thinking on relevant issues	0.409

## 6. DISCUSSION

In recent years, the number of graduate students has been increasing continuously. In order to ensure the steady improvement of their training quality under the general environment of graduate enrollment expansion, universities attach great importance to the training quality of graduate students. Methodology courses can help students master scientific and systematic research methods, help students better understand relevant research and complete scientific research tasks. Therefore, improving the classroom quality of methodology courses is the direction that universities should strive for at this stage. In this paper, Delphi method is used to discuss the classroom quality evaluation indexes of methodology courses, and finally an index system including 3 first-class indexes and 17 second-class indexes is constructed. Methodology courses can also use this index system to evaluate the teaching quality, which can further improve the index with low scores and contribute to the high-quality construction of methodology courses in colleges and universities.

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